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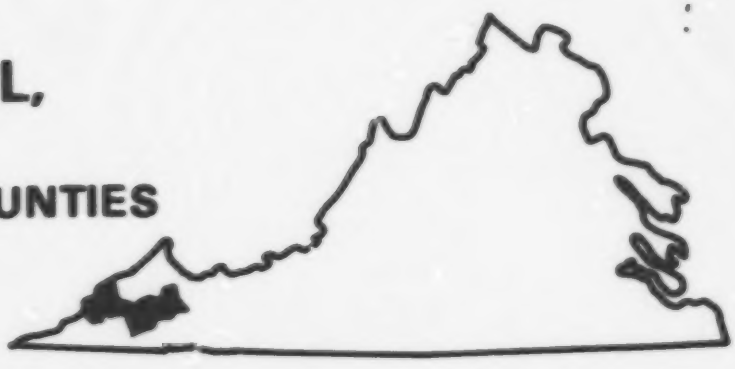
FLOOD INSURANCE STUDY

COMPLETED

TOWN OF ST. PAUL, VIRGINIA
WISE AND RUSSELL COUNTIES



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MAY 17, 1988

Federal Emergency Management Agency

COMMUNITY NUMBER - 515530

ORIGINAL

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance study purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgments	1
	1.3 Coordination	1
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	2
	2.3 Principal Flood Problems	2
	2.4 Flood Protection Measures	4
3.0	ENGINEERING METHODS	4
	3.1 Hydrologic Analyses	5
	3.2 Hydraulic Analyses	6
4.0	FLOODPLAIN MANAGEMENT APPLICATIONS	8
	4.1 Floodplain Boundaries	8
	4.2 Floodways	8
5.0	INSURANCE APPLICATION	9
6.0	FLOOD INSURANCE RATE MAP	13
7.0	OTHER STUDIES	14

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TABLE OF CONTENTS - continued

	Page
8.0 LOCATION OF DATA	14
9.0 BIBLIOGRAPHY AND REFERENCES	14

FIGURES

Figure 1 - Vicinity Map	3
Figure 2 - Floodway Schematic	12

TABLES

Table 1 - Summary of Discharges	6
Table 2 - Floodway Data	10 - 11

EXHIBITS

Exhibit 1 - Flood Profiles		
Clinch River	Panel 01P	18
Lick Creek	Panel 02P	19
Exhibit 2 - Flood Insurance Rate Map and Street Index		
Exhibit 3 - Elevation Reference Marks		

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FLOOD INSURANCE STUDY
TOWN OF ST. PAUL, WISE AND RUSSELL COUNTIES, VIRGINIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study revises and updates a previous Flood Insurance Study/Flood Insurance Rate Map for the Town of St. Paul, Wise and Russell Counties, Virginia. This information will be used by the Town of St. Paul to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP). The information will also be used by local and regional planners to further promote sound land use and floodplain development.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study represent a revision of the original analyses prepared for the Federal Emergency Management Agency (FEMA). The first Flood Insurance Rate Map for the Town of St. Paul was effective on September 2, 1970; revisions to that study were effective on July 1, 1974, and July 23, 1976. The 1970, 1974, and 1976 studies were based on work prepared by the Tennessee Valley Authority (TVA). The TVA completed a revision under Inter-Agency Agreement No. IAAH-20-75, Project Order 5, on December 18, 1975. That revision depicted curvilinear boundaries and was effective on July 23, 1976.

The hydrologic and hydraulic analyses in this updated version were prepared by TVA for FEMA, under Inter-Agency Agreement EMW-84-E-1549, Project Order 1, using information prepared for the Flood Insurance Study for the unincorporated areas of Russell County. This work was completed in August 1986.

1.3 Coordination

On May 23, 1986, the Town of St. Paul was notified by FEMA of the initiation of a revision of the Flood Insurance Study for the town.

On April 22, 1987, a final Consultation and Coordination Officer's (CCO) meeting was held with representatives from FEMA, the TVA, the

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mayor of the town, the city clerk, the St. Paul Housing Authority, and the Cumberland Plateau Planning and Development Commission to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of St. Paul, Wise and Russell Counties, Virginia. The area of study is shown on the Vicinity Map (Figure 1).

The Clinch River and Lick Creek were studied by detailed methods for their entire lengths within the community. This study was revised to incorporate updated information including a channel cutoff completed along the Clinch River. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through August 1991.

2.2 Community Description

The Town of St. Paul is located in the central portion of southwest Virginia. It is bordered by the unincorporated areas of Wise County to the north and west, and the unincorporated areas of Russell County to the south and east. The total land contained within the corporate limits of the town is 1.0 square mile. The 1980 population was 973 (Reference 1).

The town is bisected by two prominent features, the Norfolk and Western Railway and the Clinch River.

The average monthly temperatures in the town range from 74 degrees Fahrenheit (^{o}F) in summer to 35^{o}F in winter. The average annual precipitation of the region is 42 inches (Reference 2).

2.3 Principal Flood Problems

The Clinch River and Lick Creek are the principal sources of flooding in St. Paul. Information about flooding on the Clinch River is available from local residents, newspaper articles, and previous TVA reports (References 3, 4, 5, 6, 7, 8, and 9). In addition, stream gage records from 1921 to the present at the U. S. Geological Survey (USGS) gage No. 03524000 located at river mile 271.6 at Cleveland were available. These records, supplemented by prerecorded flood investigations, are indicative of past flooding on the Clinch River within the town.

The largest flood on the Clinch River since 1862 occurred on April 5, 1977, reaching an elevation of 1,470.6 feet at the city filter plant at river mile 254.76 in St. Paul. The estimated recurrence

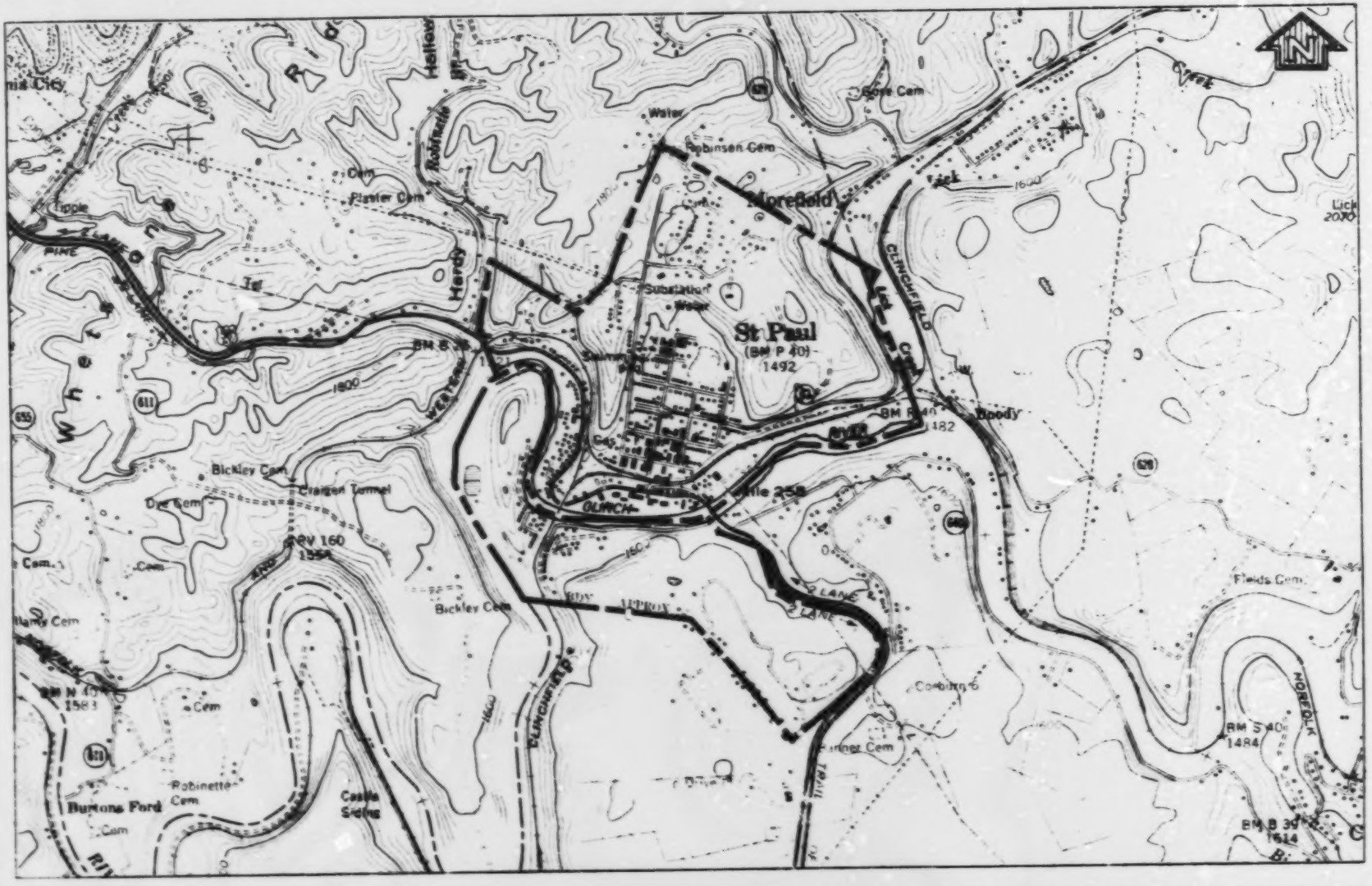

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ST. PAUL, VA

(WISE AND RUSSELL COUNTIES)

APPROXIMATE SCALE

2000 0 2000 4000 6000 FEET

VICINITY MAP

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interval of the April 5, 1977 flood was approximately 120 years. In St. Paul, 20 families were evacuated, eight major businesses were flooded along U. S. Route 58A, and one of the highway bridges suffered damage when a mobile home was forced under the steel structure. The community's new $100,000 (1977 dollars) recreation park was destroyed. The town was isolated from surrounding areas on the night of April 4 when U. S. Route 58A was flooded at both ends of town. More detailed information on the April 1977 flood is available in the 1978 TVA report No. WM-27-5-1 (Reference 4).

Other large floods that have occurred on the Clinch River at river mile 254.76 at the St. Paul filter plant are listed in the following tabulation (References 3, 4, 5, and 6):

Date of Crest	Elevation (Feet)	Peak Discharge (cfs)	Recurrence Interval (Years)
April 5, 1977	1,470.6	34,500	120
January 30, 1957	1,467.6	31,000	70
February 1862	1,468.6	27,500	40
March 12, 1963	1,466.6	27,200	35

No estimates of damage are available for Lick Creek within the community.

2.4 Flood Protection Measures

There are no flood protection structures in St. Paul. Non-structural measures of flood protection are being used to aid in the prevention of future flood damage. These are in the form of land-use regulations adopted from the Code of Federal Regulations, which control building within areas that have a high risk of flooding (Reference 10).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare

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flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

For the Clinch River, information from USGS gage No. 03524000 in Cleveland at river mile 271.6 (drainage area 466.5 square miles) and from USGS gage No. 03527000 at Speers Ferry at river mile 211.0 (drainage area 965 square miles), both with a period of record from 1921 to 1983, were used as the principal sources of data to define peak discharge-frequency relationships. Peak discharge-frequency relationships for other locations were determined by extrapolation and interpolation using these two gage points. Flood-frequency curves for these gaging stations were computed using procedures outlined in Bulletin 17B, including adjustments for historic flood information where available (Reference 11).

Regional relationships were determined for Lick Creek from the regression analysis of records at nearby stream gaging stations having similar hydrologic characteristics. The station used was USGS gage No. 03487800 near Chatham Hill, Virginia, with a drainage area of 25.50 square miles and a period of record from 1966 to 1977. Flood-frequency curves for this station were computed using procedures outlined in Bulletin 17B, including adjustments for historic flood information where available (Reference 11).

The analysis of available historic information on the Clinch River and Lick Creek indicates this information is consistent with the peak discharge-frequency relationships adopted for the stream.

Flow estimates based on the adopted regional relationships were compared to estimates made using relationships developed by the USGS for the region (Reference 12). For the range of drainage areas and channel slopes used in the hydrologic analysis, the discharges from the adopted regional relationship for the streams in the Valley and Ridge physiographic province are approximately 30 percent lower than the estimates from the USGS relationship that was developed for the hydrologic area applicable to St. Paul (hydrologic area F). The differences between the adopted regional relationships and those of the USGS result mainly from the different gaged watersheds used in each analysis. The adopted relationships were determined from gaged

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watersheds with areas less than 200 square miles and within either the Cumberland Plateau or Valley and Ridge physiographic provinces. The USGS relationships for Virginia in area F were developed using gages in the Valley and Ridge as well as the Blue Ridge physiographic provinces. Most of the watersheds in the Valley and Ridge province are distinctly different from those on the Cumberland Plateau. The Blue Ridge physiographic province is far enough from Russell County that it is judged meteorologically different. Also, approximately half of the watersheds used in the USGS relationships were larger than 200 square miles and were judged inappropriate for comparison with Lick Creek.

A summary of drainage area-peak discharge relationships for the Clinch River and Lick Creek is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)*	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CLINCH RIVER					
At river mile 253.0 (approximately 0.53 mile downstream of Clinchfield Railway)	557.5	23,000	34,000	39,000	53,000
At river mile 255.6, downstream of Lick Creek (approximately 0.63 mile upstream of U. S. Route 58)	554.9	23,000	34,000	39,000	53,000
At river mile 255.6, upstream of confluence of Lick Creek (approximately 0.73 mile upstream of U. S. Route 58)	529.2	22,000	33,000	37,000	51,000
LICK CREEK					
At confluence with Clinch River	26.1	3,405	5,345	6,300	9,100

*Net area excluding sinks

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

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Cross sections were field surveyed at bridges and other strategic locations and were supplemented by valley cross sections taken by photogrammetric methods (Reference 13). The photogrammetric methods involved the use of overlapping pairs of aerial photographs (flown in April 1984, scale 1:12,000) for a predetermined flight path and height in a stereoplotter oriented between both exposures and with photo-identifiable points on an engineering map base set in the frame of an output plotter. The aerial photographs were used to compile topographic maps that were used to obtain additional cross sections.

The stereo models are controlled horizontally by existing map features and vertically by both existing and newly acquired surveyed elevations. Using the stereo model, coordinates of points along the cross sections were measured and recorded. The trace of the desired location of each section is on the output plotter. Cross sections were taken at close intervals to accurately compute water-surface elevations. All bridges were surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the U. S. Army Corps of Engineers (COE) HEC-2 step-backwater computer program (Reference 14). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for the Clinch River and Lick Creek were calculated by the slope/area method.

Channel roughness factors (Manning's "n") used in the hydraulic computations were determined on the basis of field inspection of the channels and floodplain areas, previous studies by TVA, and computed coefficients based on known flood profiles. The channel "n" values for the Clinch River ranged from 0.026 to 0.051, and the overbank "n" values ranged from 0.030 to 0.090. For Lick Creek, the channel "n" values ranged from 0.035 to 0.050, and the overbank "n" values ranged from 0.080 to 0.150.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

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4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4,800 with a contour interval of 4 feet (Reference 15).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zone AE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

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The floodways presented in this study were computed for certain stream segments by setting encroachments in the stream overbanks, testing these with the HEC-2 program, and adjusting and retesting them until an allowable increase in flood elevation was reached (Reference 14). This procedure has been used for many years to provide technical floodplain management assistance to Tennessee Valley communities.

In this procedure, the floodway limit lines are located to allow the use of some presently flood-prone areas at the expense of some increases in flood levels. The limit lines are located in a manner that provides land where it is estimated to serve the community's needs best. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 2). The computed floodway is shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 2 for certain downstream cross sections of Lick Creek are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	[1,2] DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Clinch River								
A	254.64	180[3]	4,085	9.5	1,468.3	1,468.3	1,468.5	0.2
B	254.96	290[3]	5,870	6.6	1,470.1	1,470.1	1,470.9	0.8
C	255.03	320[3]	6,859	5.7	1,470.4	1,470.4	1,471.0	0.6

[1]Stream distances represent established TVA river miles and may not reflect actual distances as shown on the map
[2]Miles above confluence with Tennessee River
[3]This width extends beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ST. PAUL, VA
(WISE AND RUSSELL COS.)

FLOODWAY DATA

CLINCH RIVER

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1,2]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Lick Creek								
A	0.155	160[3]	784	8.1	1,471.4	1,467.8[5]	1,468.8	1.0
B	0.324	75[4]	431	14.6	1,473.3	1,473.3	1,473.3	0.0

[1]Stream distances represent established TVA river miles and may not reflect actual distances as shown on the map
[2]Miles above confluence with Clinch River [4]This width extends beyond corporate limits [5]Elevation computed without consideration of backwater effects from Clinch River
[3]This width extends entirely outside corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ST. PAUL, VA
(WISE AND RUSSELL COS.)

FLOODWAY DATA

LICK CREEK

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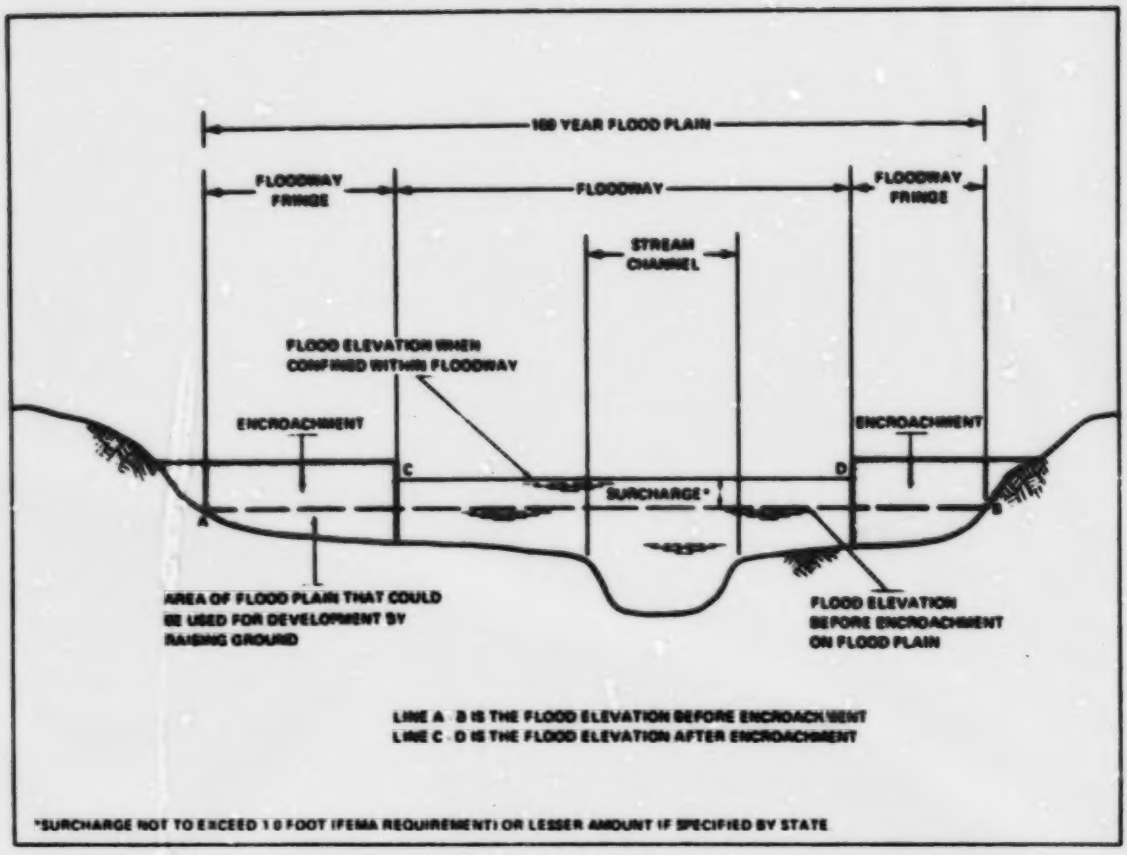
100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FLOODWAY SCHEMATIC Figure 2

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

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Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

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For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

TVA has prepared two floodplain information reports that contain primarily historic flood information plus potential effects of a very large theoretical flood (References 3 and 16).

A Flood Insurance Study for the unincorporated areas of Russell County is currently being prepared (Reference 17). The results of that study will be in complete agreement with the results of this study.

A Flood Insurance Study for the unincorporated areas of Wise County has been published (Reference 18). The results of this study are in agreement with the results of that study.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region III Office, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

9.0 BIBLIOGRAPHY AND REFERENCES

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EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	Elevation (Feet NGVD)	Description of Location
RM 1	1,468.21	Chiseled square on top of east bank on downstream concrete guardrail of State Route 628 bridge at Lick Creek mile 0.13.

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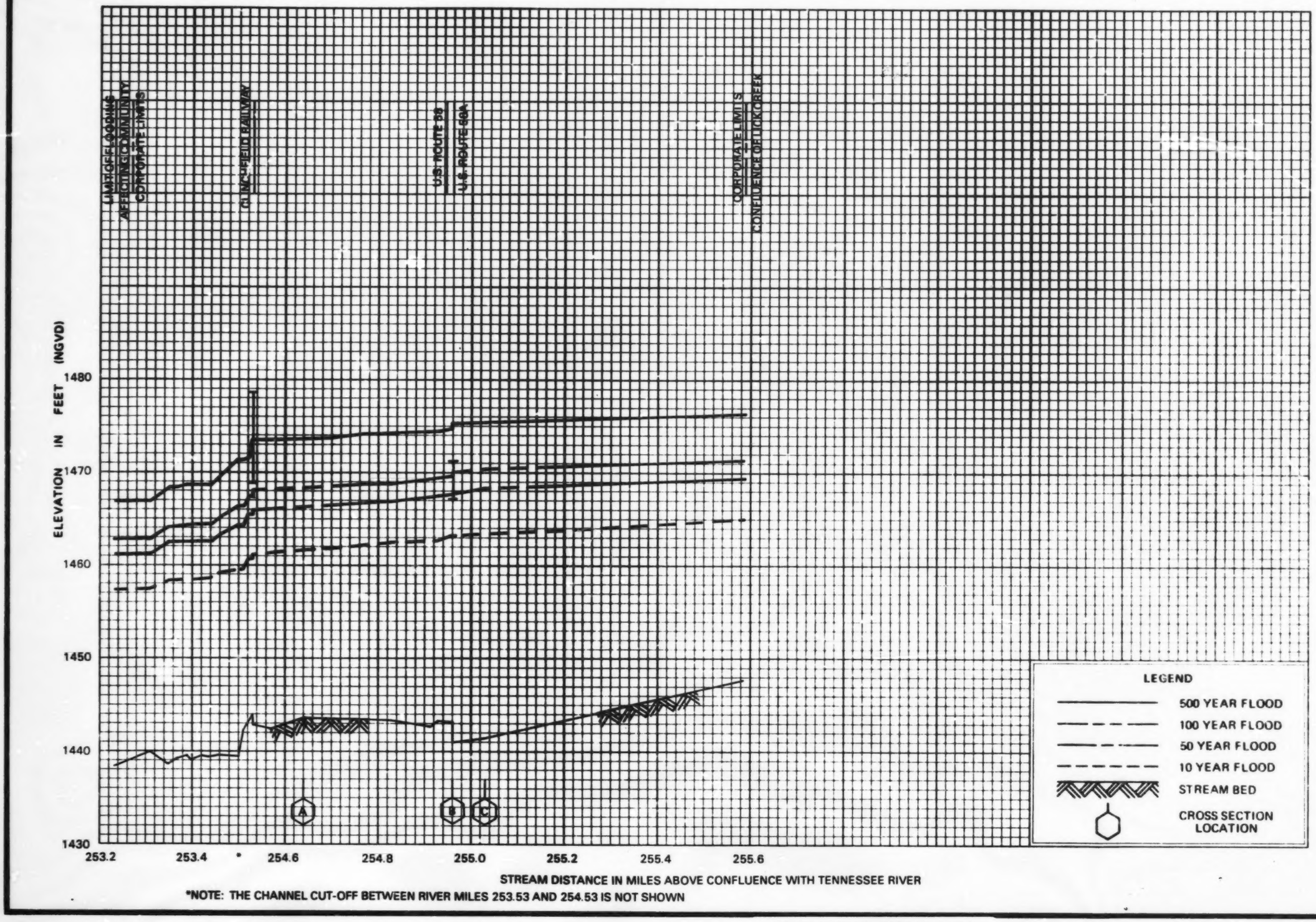

FLOOD PROFILES

CLINCH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ST. PAUL, VA
(WISE AND RUSSELL COUNTIES)

01P

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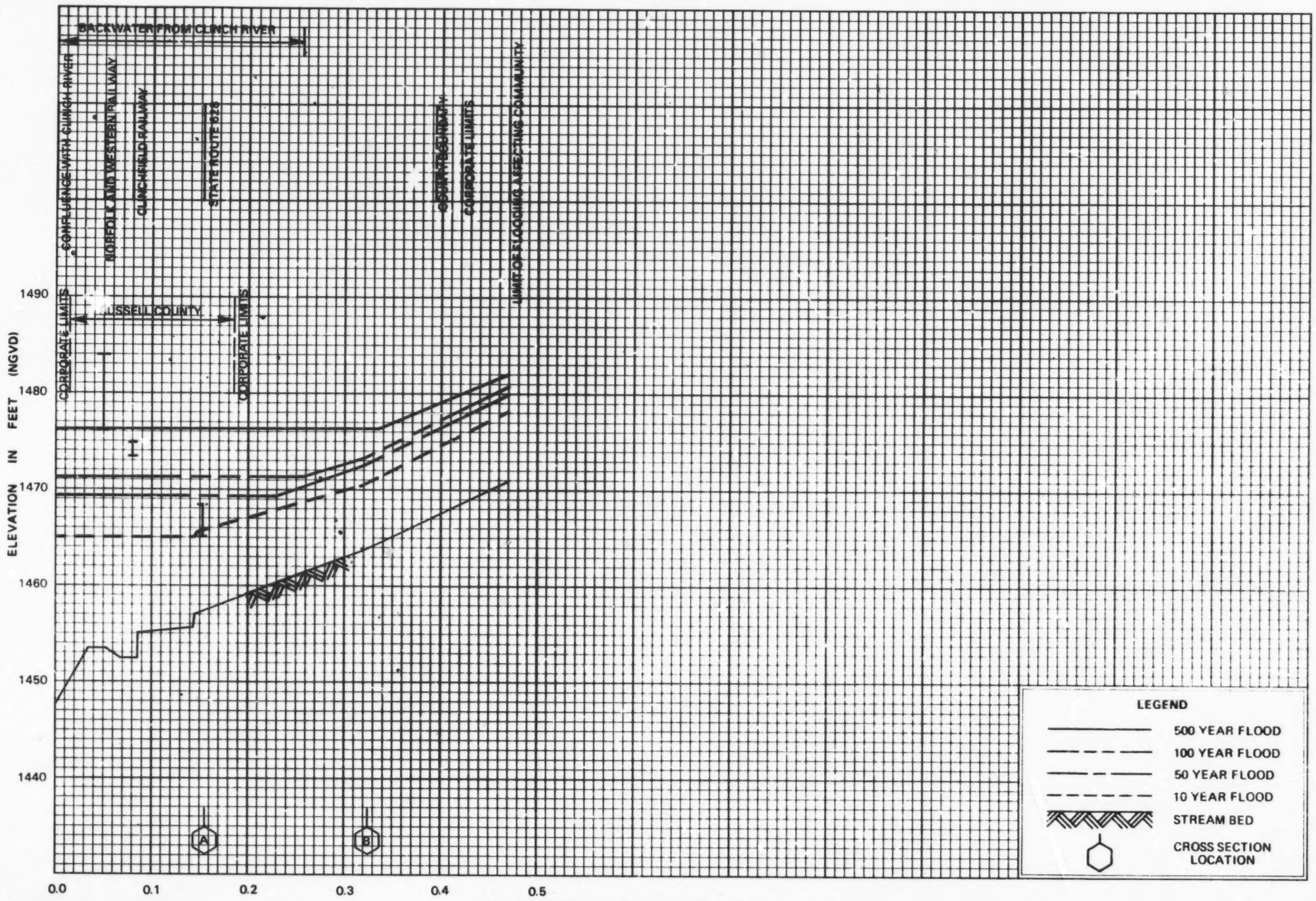

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FLOOD PROFILES

LICK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF ST. PAUL, VA

(WISE AND RUSSELL COUNTIES)

02P